REMARKS

By this amendment, applicants have amended claim 2 to recite that the second and third steps are executed in continuous succession after the first step in the same apparatus. See, the paragraph bridging pages 6 and 7 of applicants' specification. Claim 5 has been canceled without prejudice or disclaimer.

Claims 1 - 7 stand rejected under 35 USC 103(a) as allegedly being unpatentable over United States Patent No. 6,069,035 to O'Donnell et al in view of United States Patent No. 5,269,878 to Page et al and further in view of United States Patent No. 4,693,777 to Hazano et al. Applicants traverse this rejection and request reconsideration thereof.

The present invention relates to a method of processing a sample, for example, a method of manufacture of a magnetic head, which includes plasma etching of a specimen which is a lamination layer having at least one layer made of NiFe alloy or NiFeCo alloy. As recited in claims 1 - 7, the method includes a first step of etching the specimen, which is a lamination layer formed on a substrate and includes at least one layer made of NiFe alloy or NiFeCo alloy, by gas plasma with a gas which contains chlorine at a temperature of the specimen below 200°C in an etching chamber. The method includes a second step, which is performed immediately after the first step, of removing a residual chlorine component deposited on an exposed portion of the lamination layer during the first step, and eliminating debris deposited on a side wall thereof by rinsing the same using at least one liquid, and a third step of drying a specimen immediately after the rinsing thereof by placing the specimen on a hot plate and by heating the specimen at a temperature below 200°C. Applicants have found that if the rinsing step is performed immediately after

the etching step and the drying step is performed immediately after the rinsing step, a number of advantages are obtained, including corrosion prevention. See, the paragraph bridging pages 22 and 23 of applicants' specification and Figure 11.

The patent to O'Donnell et al discloses a method for etching at least partially through a transition metal-containing layer. The method includes plasma processing the sample using the source gas that includes HCl and Ar and, after etching, rinsing the substrate using an appropriate rinsing solution to remove soluble chlorides of transition metals. However, as admitted by the Examiner, the O'Donnell et al patent does not disclose the method of the present invention, including a step of drying the specimen immediately after the rinsing by placing the specimen on a hot plate and by heating the specimen at a temperature below 200°C.

The patent to Page et al discloses that after a metal deposition is patterned using a plasma etch, the metal pattern is sprayed with steam and water. The metal deposition in Page et al is a metal layer of an integrated circuit wafer and includes a lower titanium-tungsten adhesive sublayer, a copper-aluminum bulk conductor sublayer and an upper titanium-tungsten adhesive sublayer. The Page et al patent discloses spraying and drying of the wafer after etching and discloses that the spraying and drying can be performed with spinning or without spinning, e.g., on a hot plate. However, the Page et al patent is not directed to etching a specimen which is a lamination layer formed on the substrate and which includes at least one layer made of NiFe alloy or NiFeCo alloy, and does not disclose rinsing the specimen immediately after etching and drying the specimen immediately after rinsing by placing the specimen on a hot plate and by heating the specimen at a temperature below 200°C.

The patent to Hazano et al discloses an apparatus for producing semiconductor devices in which a plurality of treatment chambers, including a heat-treatment chamber, are connected in series. The Hazano et al patent appears to be directed to etching aluminum layers on wafers. This patent discloses that a heat-treatment chamber is included downstream of the etching chamber to heat the wafer both by air nozzles and a hot plate. A water-rinse chuck is disposed on the downstream side of the heat-treatment chamber. In the fourth embodiment described at column 11, line 31 et. seq. it is disclosed that, after the etching and N_2-gas chamber, the wafers are transferred into a post treatment chamber for water rinsing or heat-treatment. The Hazano et al patent is not directed to etching of a lamination layer including at least one layer made of NiFe alloy or NiFeCo alloy and does not disclose performing rinsing immediately after the etching and performing drying immediately after rinsing by placing the specimen on a hot plate and by heating the specimen at a temperature below 200°C. Rather, the Hazano et al patent discloses etching of aluminum and appears to disclose rinsing after the heat treatment after using the air nozzles and hot plates.

Clearly, none of O'Donnell et al, Page et al and Hazano et al discloses etching of a lamination layer including at least one layer made of NiFe alloy or NiFeCo alloy by gas plasma with a gas which contains chlorine at a temperature of the specimen below 200°C, immediately thereafter rinsing and, immediately thereafter, drying the specimen by placing the specimen on a hot plate and by heating the specimen at a temperature below 200°C. In this regard, the O'Donnell patent does not disclose, inter alia, drying the specimen immediately after rinsing by placing the specimen on a hot plate and by heating the specimen at a temperature

below 200°C; the Page et al patent is directed to etching of a different type of metal deposition and, while disclosing rinsing and drying, does not disclose drying the specimen immediately after the rinsing by placing the specimen on a hot plate and by heating the specimen at a temperature below 200°C; the Hazano et al patent relates to processing different metal layers and does not disclose rinsing and immediately after the rinsing placing the specimen on a hot plate and heating the specimen at a temperature below 200°C for drying the specimen after the rinsing step.

Applicants submit that because the three patents relate to processing of different metal containing layers, one of ordinary skill in the art would not have been motivated to combine the teachings of these patents in the manner urged by the Examiner. In particular, if the metals to be etched are different, their corrosion advancing speeds and corrosion advancing mechanisms are significantly different from each other. Accordingly, the counter measures for preventing corrosion must be different for each metal to be etched. Therefore, individual studies of corrosion preventing methods for each of the individual target materials are required. The present invention is the result of one such study.

More specifically, when etching Al with Cl_2, a local corrosion called pitting corrosion is caused by residual Cl_2 at a bottom corner of the pattern. Such corrosion can be prevented by water rinsing and spin drying processing as disclosed in Page et al.

In contrast, after etching transition metals such as NiFe with Cl_2, rust-like corrosion is caused over the entire etching face. Generally, corrosion phenomenon in NiFe is more severe than that in Al and the corrosion mechanism for NiFe seems

different from that for Al.

Namely, in the case of NiFe, since the etching advances slowly in the dry etching step, the etching is performed by increasing the energy level of the irradiation ions to about 1000V, which is three times higher than that for Al. However, due to the influence of the high energy level, it seems that the Cl atoms are implanted deeply from the surface of the NiFe material, which makes releasing of Cl atoms difficult.

In the case of Al, since the volatility of the reaction product $AlCl_3$ is high, the Cl atoms are easily released and pitting corrosion is locally caused only at portions such as at the corner portion where Cl_2 likely remains. Thus, corrosion can be fairly easily prevented by water rinsing and spin drying as disclosed in Page et al.

However, a corrosion preventing after-processing treatment specific to NiFe which is different from that for Al is required after etching NiFe or NiFeCo. Through many experiments, the inventors found out that if, immediately after the etching, water rinsing, e.g., of more than two minutes, is performed and immediately thereafter, e.g., within 10 seconds, a drying heat treatment for, e.g., more than two minutes is performed with a hot plate heated at about 200°C, complete corrosion prevention for NiFe can be achieved.

The corrosion prevention treatment presently claimed which is performed immediately after etching of a lamination layer that includes at least one layer made of NiFe alloy or NiFeCo alloy is not disclosed by O'Donnell et al. Both the Page et al and Hazano et al patents are not directed to etching of NiFe or NiFeCo and would provide no motivation for modifying the method described in O'Donnell et al. Moreover, even assuming, arguendo, one of ordinary skill in the art would have

combined the teachings of Page et al and Hazano et al with those of O'Donnell et al, the Page et al patent does not disclose a step of drying the specimen immediately after rinsing by placing the specimen on a hot plate and heating the specimen at a temperature below 200°C. The Hazano et al patent appears to disclose rinsing of the specimen after heating, not drying the specimen after rinsing as presently claimed.

Accordingly, the presently claimed invention is patentable over the proposed combination of O'Donnell et al, Page, et al and Hazano et al.

Claim 8 stands rejected under 35 USC 103(a) as being unpatentable of O'Donnell et al, Page et al and Hazano et al and further in view of United States Patent No. 5,520,716 to Takagi et al. Applicants traverse this rejection and request reconsideration thereof.

The Takagi et al patent discloses a AlO_3, TiC sintered product and substrate for magnetic heads, but does not remedy any of the basic deficiencies noted above with respect to O'Donnell et al, Page et al and Hazano et al. Accordingly, claim 8 is patentable over the proposed combination of references, at least for the reasons noted above.

Claim 14 stands rejected under 35 USC 103(a) as being unpatentable over United States Patent No. 6,282,776 to Otsuka et al in view of O'Donnell et al, Page et al and Hazano et al. Applicants traverse this rejection and request reconsideration thereof.

The Otsuka et al patent is directed to a method of manufacturing a magnetic head comprising the steps of forming a lower recording magnetic pole and an upper recording magnetic pole, and trimming partially an elongated pole in the vicinity of a

floating surface of the upper recording magnetic pole and an upper portion of the lower recording magnetic pole positioned below and around the elongated pole by an ion milling method, wherein a core width of the elongated pole can be adjusted. However, as admitted by the Examiner, this patent does not disclose performing rinsing and drying steps after an etching step for corrosion prevention. Specifically, this patent does not disclose removing residual chlorine and fluorine components by liquid rinsing immediately after etching a gap layer and drying the rinsed body formed by the above steps by heating at a temperature below 200°C after placing the same on a hot plate.

For the reasons noted above, the combination of O'Donnell et al, Page et al and Hazano et al does not suggest removing residual chlorine and/or fluorine components by liquid rinsing and drying the rinse body by heating at a temperature below 200°C after placing the rinse body on a hot plate. Accordingly, claim 14 is patentable over the proposed combination of references.

Claim 13, 15 - 18, 20, 22 and 23 stand rejected under 35 USC 103(a) as being unpatentable over Otsuka et al in view of O'Donnell et al, Page et al and Hazano et al and further in view of United States Patent No. 5,607,599 to Ichihara et al. Applicants traverse this rejection and request reconsideration thereof.

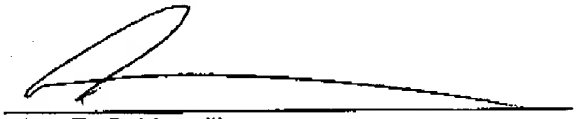
The Examiner cites the Ichihara et al patent as allegedly teaching etching NiFe alloy layers such as seed and shield layers with an argon and chlorine plasma. However, clearly the Ichihara et al patent does not remedy any of the basic deficiencies noted above with respect to Otsuka et al, O'Donnell et al, Page et al and Hazano et al. Accordingly, the claims are patentable over the proposed combination of references, at least for the reasons noted above.

In view of the foregoing amendments and remarks, favorable reconsideration and allowance of all of the claims now in the application are requested.

To the extent necessary, applicants petition for an extension of time under 37 CFR 1.136. Please charge any shortage in the fees due in connection with the filing of this paper, including extension of time fees, to the deposit account of Antonelli, Terry, Stout & Kraus, LLP, Deposit Account No. 01-2135 (Case: 503.38156X00), and please credit any excess fees to such deposit account.

Respectfully submitted,

ANTONELLI, TERRY, STOUT & KRAUS, LLP



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